




SMUD's Energy Storage and Open ADR Activities

CEC Staff Workshop on Energy Storage and Automated Demand Response Technologies to Support Renewable Energy Integration

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The Power To Do More.℠






What Is Driving SMUD's Renewables & Storage Interest?

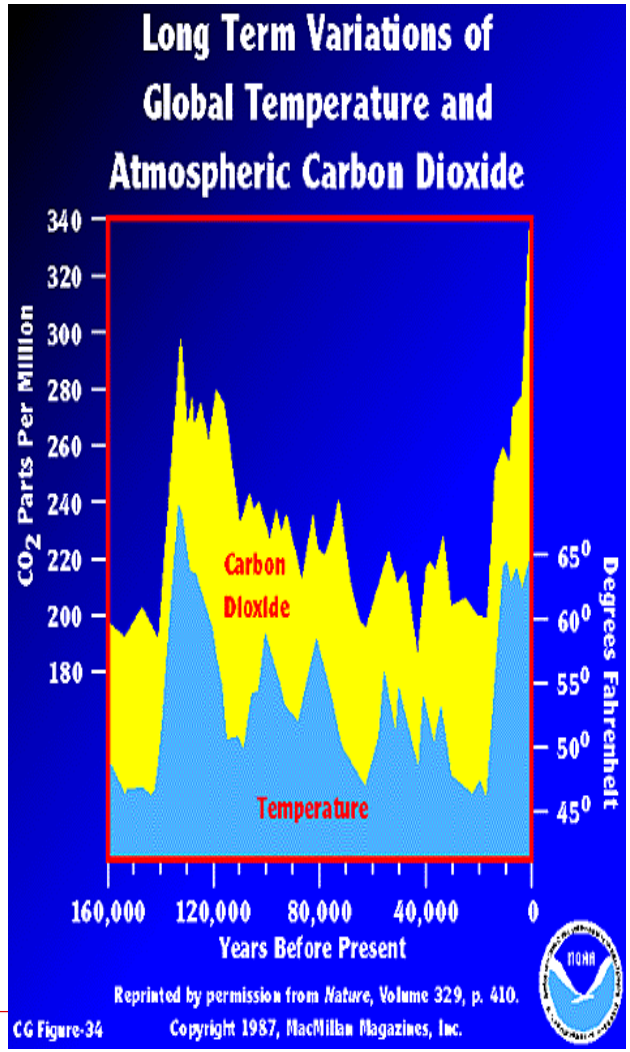
- GHG regulations
  - Reshaping energy supply
  - Prompting PHEV development
- RPS and wind and solar energy additions
  - Transmission development issues
  - Wind — weak forecasting, large ramps, unpredictable production during super peaks
  - Solar — peaks 4-5 hours before utility peak
- Summer peak load
  - 400 MW problem for 40 hours






Sustainable Energy Supply Policy

- Reduces SMUD's long-term ***greenhouse gas emissions to 10% of its 1990 carbon dioxide emission levels by 2050*** (<350,000 metric tonnes/ year), while ***assuring reliability of the system; minimizing environmental impacts***; and ***maintaining a competitive position*** relative to other California electricity providers.



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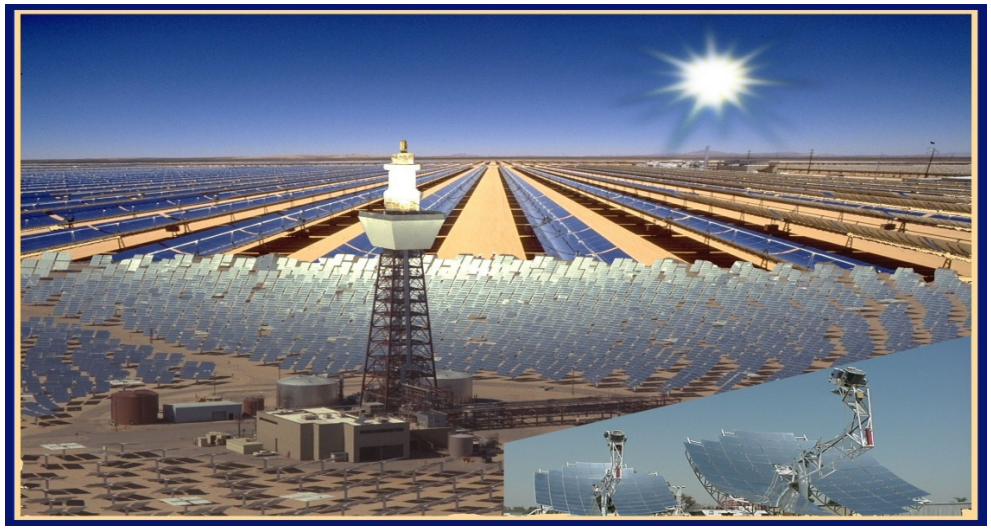
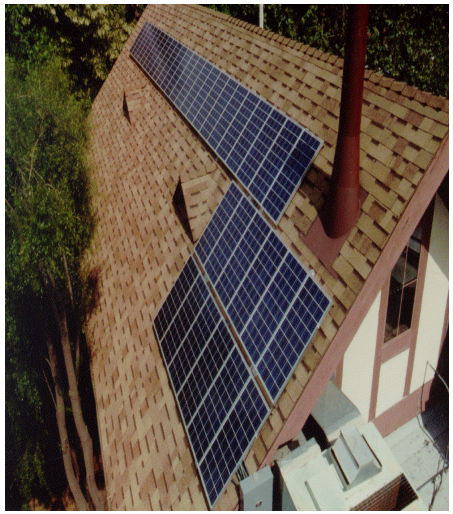
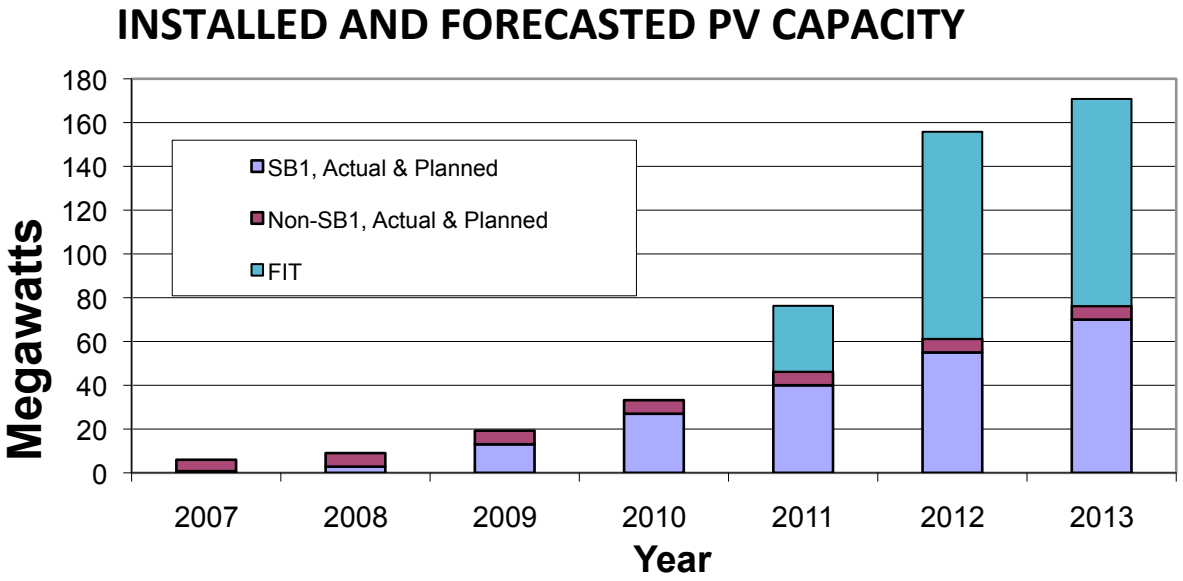
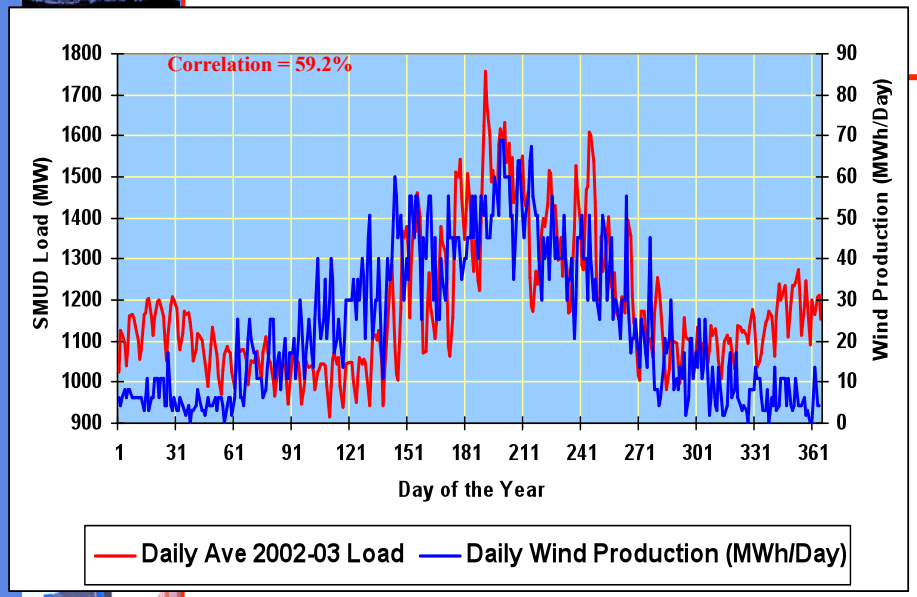
Solar Energy's Growing Role

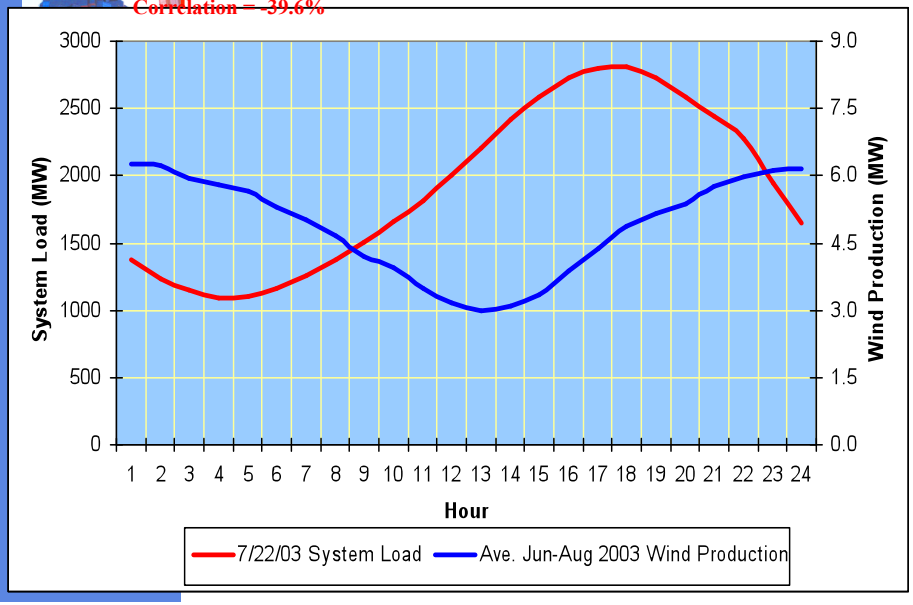






Wind Issues For SMUD





- SMUD's peak load driven by hot summer temperatures
- Wind resource weakest on hottest days
- Comparing daily and hourly system load with Solano Wind Plant production illustrates mismatch
- Must rely on firming resources to address mismatch and ensure system stability






SMUD's Storage Approach

- SMUD is evaluating bulk **and** distributed storage
- Questions of what kind, how much of it and when, how to quantify value, and how much cost
- Pursuing a multi-pronged approach
  1. Developing improved understanding of storage technologies
  2. Determining benefits of distributed storage to SMUD
  3. Conducting some demonstrations, monitoring performance and cost effectiveness
  4. Preparing SMUD for energy storage utilization
- Conducting Studies on Bulk (CAES, Pumped Storage) and Distributed Storage (Li-Ion & Flow Batteries)

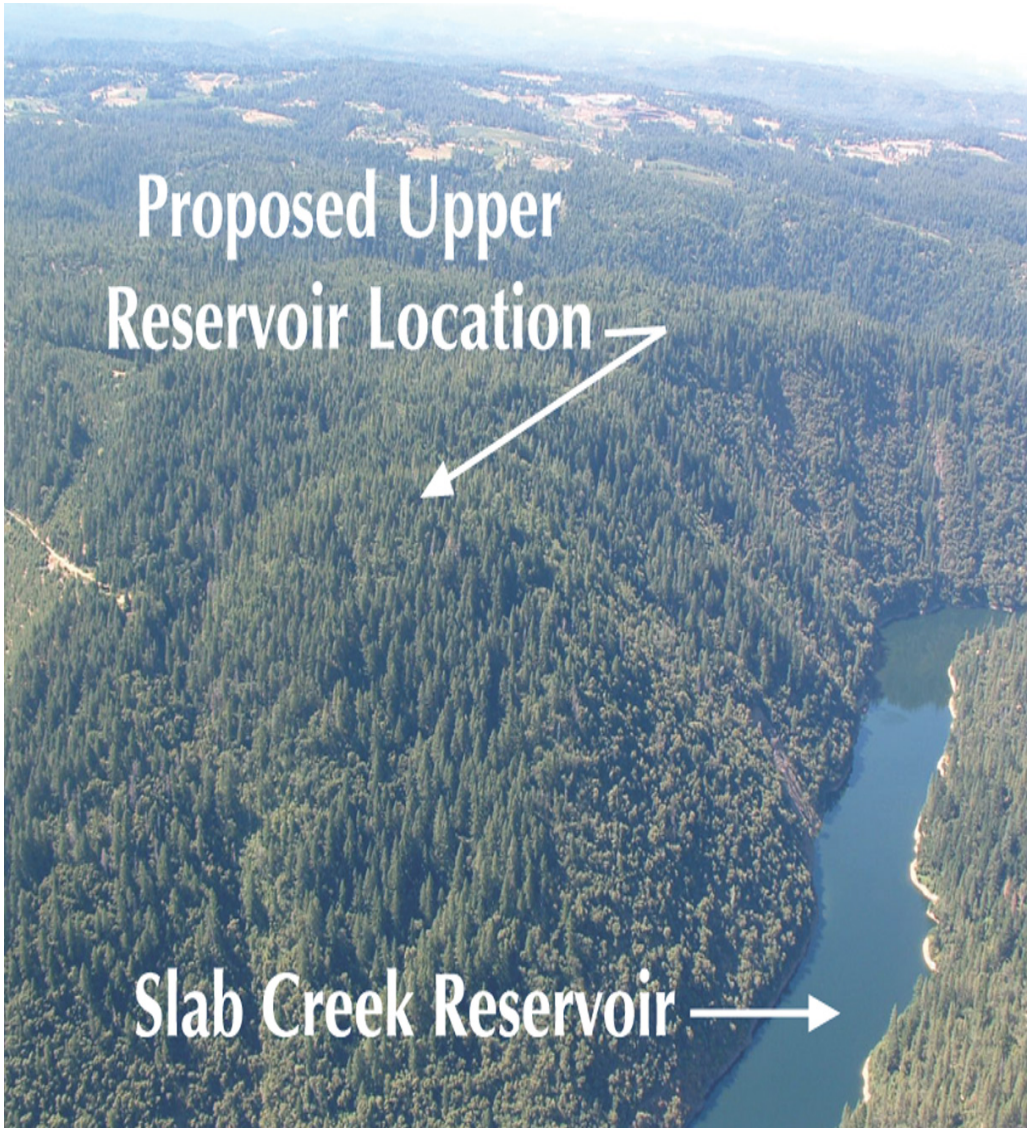
SMUD's Proposed Pumped Hydro Project

Key Features of Iowa Hill

- New development added to existing hydro system
- 400-MW Pumped-storage facility
- New 6,400 ac-ft reservoir atop Iowa Hill
- Existing Slab Creek Reservoir as lower reservoir
- Underground water conveyance and powerhouse
- 2.5-mile transmission tie-in connects to existing UARP transmission line

Benefits

- Helps meet load growth
- Enables firming capacity of intermittent, non-dispatchable renewables
- Supports load following, improves system reliability, provides voltage control and spinning reserves




Tree Clear Radius: 500ft
Height Above Ground: 652.6ft
1
4
10
11
12
5
3
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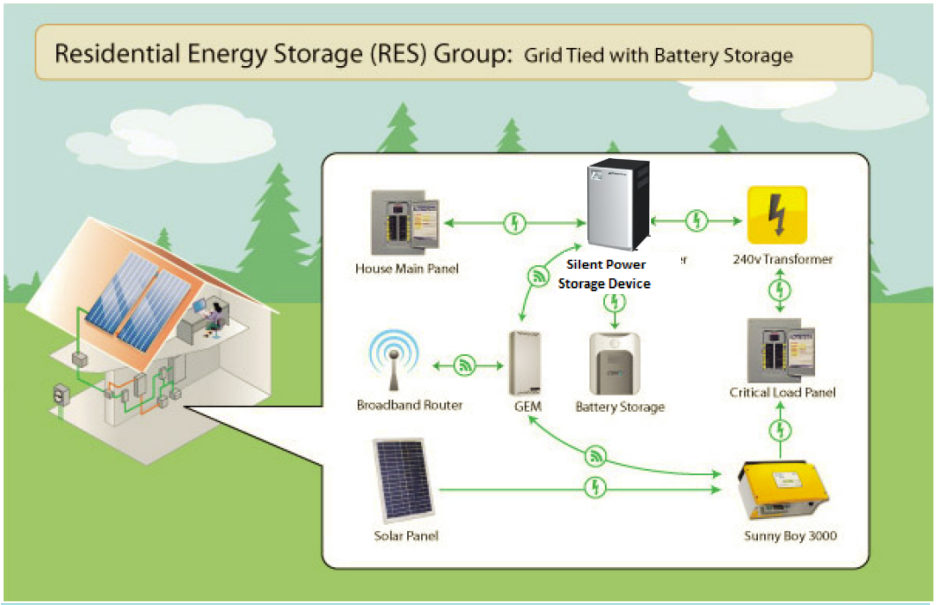
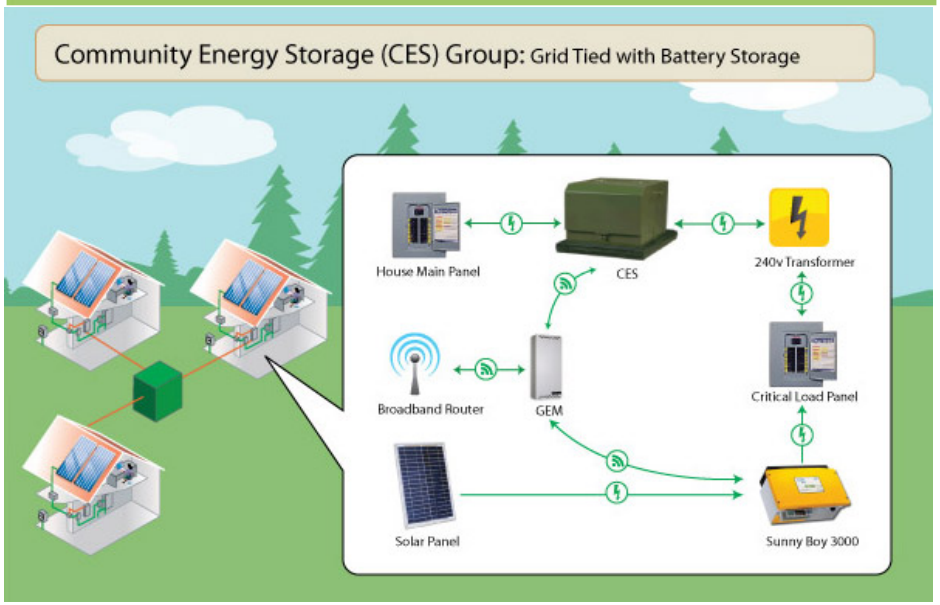
9
13

SMUD PV & Smart Grid Pilot at Anatolia

ARRA FOA 85 Topic 4: High Penetration Solar Development



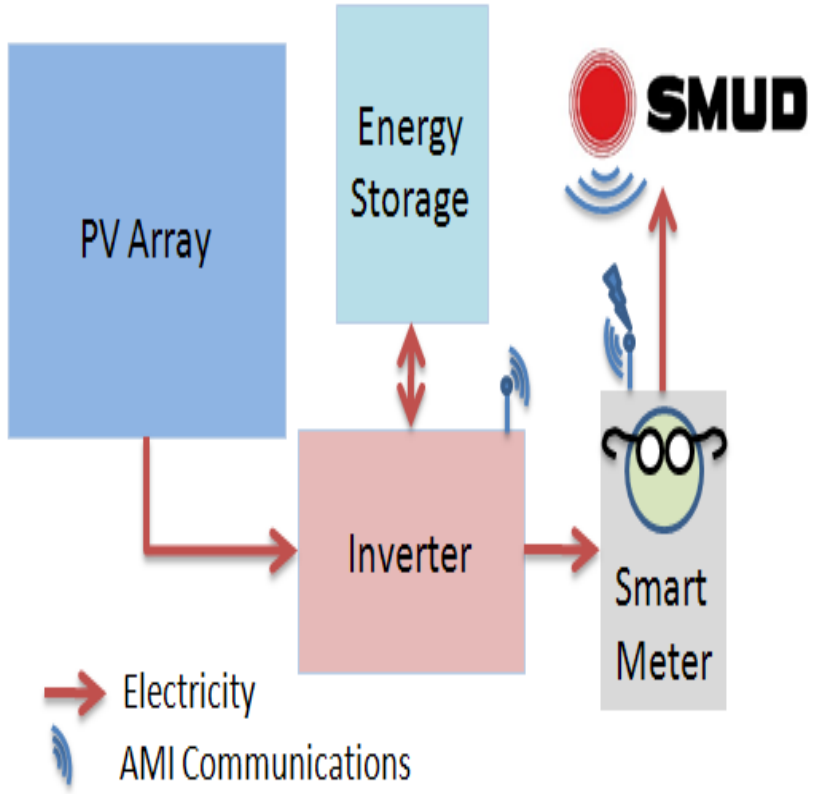


- Partners include CEC, GridPoint, SunPower, Navigant, NREL
- Will firm renewables, reduce peak load and improve reliability
- Installing 15 RES and 3 CES units in Anatolia SolarSmart^{SM} Homes that currently have 2kW PV systems
- Installing utility and customer portals to monitor PV, storage, customer load
- Sending price signals to affect changes in customer usage
- Developing specification for smart meter/inverter interface to enable management of distributed PV/storage system with AMI
- Quantifying costs and benefits of this storage deployment to gain insights to broader application for SMUD

SMUD PV & Smart Grid Pilot at Anatolia (Cont'd)

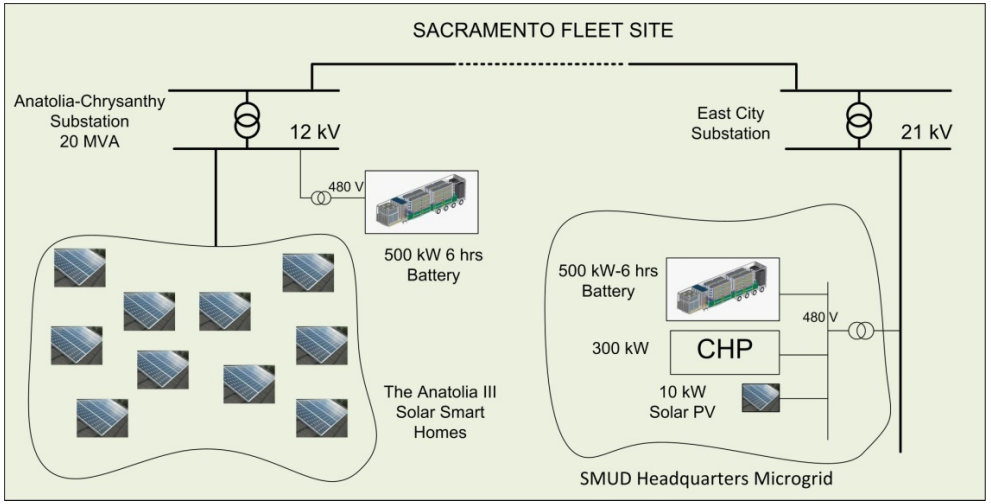
Inverter Communications

- Demonstrate Inverter Monitoring via AMI communication from smart meter to inverter
- Demonstrate receiving data, querying for faults, sending control signals
- Utilized as actively controlled contributors versus passive devices on the grid



Storage for Grid Support

ARRA FOA 36 Topic 2.3: Regional Smart Grid Demos



Benefit	Metric	Sacramento Fleet
Peak load reduction	Peak Load	5-10%
T&D loss reduction	T&D Losses	2%
Reduced cost of power interruption	CAIDI/SAIDI/SAIFI improvements	10%
Reduced damages as a result of lower GHG/carbon emissions	MWh served by renewable sources	TBD
Reduced cost to serve peak energy (energy arbitrage)	Hourly marginal cost data	70%

- Partners include CEC, Premium Power, National Grid, SAIC, NREL, Syracuse University
- Will firm renewables, reduce peak load and cost to serve peak, and improve reliability
- Installing two 500kW – 6 hours systems
- Operating as a fleet of distribution assets
- Quantifying costs and benefits of this storage deployment to gain insights to broader application for SMUD






Current/Future Projects with CEC

1. **Plug in electric vehicle grid impact study**
   - Study the effects of electric vehicle charging cycles on residential distribution transformers – 25 kVA, 50 kVA and 75 kVA
   - Develop battery pack to simulate 1-5 electric vehicles and plug into loaded transformers to test impacts
2. **Battery/PV optimization**
   - Install ~150 kW flow battery at electric vehicle charging facility (20 – level 2 and 1 – level 3) with 80 kW of PV to test grid optimization through the battery



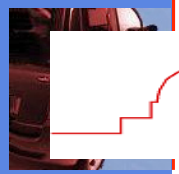



Open ADR (Auto DR)

- SMUD has $1.5 million in the ARRA SGIG contract for auto DR
- Auto DR will be incorporated in partner locations first (LRCCD, CSUS, DGS)
- RFP process to hire consultant/implementation contractor
- Results from partner projects will roll into customer program





Summary

- Storage and demand response will play a significant role in SMUD's future
  - SMUD GHG goals & RPS driving SMUD to more renewables, creating a need for more storage and demand response
  - Transmission constraints driving SMUD to local solutions
  - Looking to Smart Grid technologies to help optimize grid operations, intermittent resources, distributed generation, two-way power flow, etc.
  - Storage could be a viable mitigation solution that provides multiple benefits